RPC Safety System Blue Sheet Certification Test Procedure

procedure name

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REVISION CONTROL SHEET

LETTER	DESCRIPTION	DATE	AUTHOR	APPROVED BY	CURRENT OVERSIGHT
A	First Issue	1/18/2008	P. Giannotti		P. Giannotti

RPC Safety System Blue Sheet Certification Test Procedure

1.0   General System Description of Operation

The RPC Facility Safety System monitors conditions inside & outside the tented structure and, upon detection of ***major*** safety faults, will cause interruption of the 208 volt and 120 volt AC power distribution network inside the tent. Additionally, the major faults will cause the RPC gas supply (solenoid operated) valves to close, thereby terminating gas flow into the detector chambers under production & test inside the tent. The system will also detect ***minor*** alarm conditions. The major & minor alarms will be transmitted to pre-assigned alarm response personnel and/or system experts in the form of pre-recorded messages and received on cell/home phones or BNL phones in the MCR, CAS Watch Station or PCR.

The following **major** safety faults will trip electric power and close the three gas valves supplying Isobutane, Sulfurhexafluoride, and Freon (R134A) gasses.

1) **High level smoke sensed inside the tent.** (BNL Fire/Rescue Group response)
2) **Flammable gas high level sensed inside or outside the tent.** (CAS Watch response)
3) **Emergency stop (crash) push button stations inside or outside the tent.**

The following **major** safety fault will <u>not</u> trip electric power, however, it will close the three gas valves:

1) **SF6 gas high level sensed inside or outside the tent.** (CAS Watch response)

The following **major** safety faults will cause evacuation horns/strobe lights to report at locations inside and outside the RPC Tent:

    1) SF6 gas high level – BLUE color strobe lens.
    2) Flammable gas high level – YELLOW color strobe lens.

The following **minor** safety faults will only send a phone alarm message:

1) **Flammable gas monitor low level alarm or malfunction.**
2) **SF6 gas monitor low level alarm or malfunction.**

The smoke alarm zone is monitored by the BNL FIRE Rescue Group and a zone trip will cause emergency personnel & equipment to respond at the RPC facility.

Design Philosophy

The RPC Safety System is designed around individual trip channels consisting of 24 volt DC relay latching circuits. Each of the trip channels receive a dry contact input originating at the monitoring instrument's contact output (gas monitors, fire alarm panel, crash buttons).
Under normal conditions the monitor's output contact is closed and the trip channel's relay is latched ON (energized). An abnormal condition will cause the contact to open, unlatch (de-energize) the relay and the protective action will be initiated. Any broken wires, loose connections, or loss of control power to the relay logic or safety instruments will cause the trip relays to de-energize. This design philosophy is therefore considered "Fail-Safe".
  Some trip relays are connected into a relay logic "AND" circuit which controls the 480 volt main contactor feeding power into the 480/208/120 volt transformer. The main transformer's secondary winding connects to the RPC Tent power distribution breaker panel. All trip channels must be satisfied <u>normal</u> in order to manually reset (latch ON) the main contactor or re-open the gas valves.

The RPC Safety System is modeled after the PHENIX Safety System and functions similarly.

Controls and Indicators

The Safety System input/output controls with visual indicators are contained in a single electronics rack (RPC-SS-R) (78" high x 24" wide x 36" deep). The rack is located outside the tent near its south east corner.

The rack front panel displays the four major fault conditions via flashing red illuminated push buttons (trip resets). The total number of red push button lights is six (two are spare trip channels for future use, if needed). A major fault condition will also cause the Trip Signal Reset push button to illuminate.

An illuminated knob operated switch allows the system expert to restore the RPC tent power following a trip and only after the faults are first investigated, cleared from the detection instruments & manually reset from the front panel (in that order). This switch directly controls the 200 amp 480 volt AC main power contactor which is located on the high bay north wall. A power OFF position is not provided on the switch. The only way to trip OFF the main contactor is through the safety channel inputs. The easiest way to do this is through the crash push buttons (channel 4).

The major faults will also cause the rack alarm horn to report and be heard in the high bay vicinity. The horn can be silenced via an "alarm silence" pushbutton on the rack. Additionally, personnel evacuation alarm horn/strobe lights will turn on for the conditions of high flammable gas (Yellow color) and high level SF6 gas (Blue color). The evacuation horns/lights will also be turned off via the silence button.

Gas Valves

There are three 24 volt DC (de-energize, fail closed) solenoid operated valves supplying gas into the RPC chambers. When their solenoids are energized, the valves OPEN. All valves can be manually switched ON or OFF, simultaneously, from the gas valve control station (Gas Mixing Panel – GMP) located outside the tent as long as the safety faults are reset. The valves are simultaneously switched OFF, automatically, if the Safety System detects a fault.

Bypass Box

Each trip channel is provided with a Bypass Switch. Whenever maintenance or calibration of the instrumentation is performed, the channel can be placed in bypass, thereby preventing trip actions until the activity is completed. The phone dialer's inputs can also be bypassed to prevent nuisance alarms during maintenance. The Bypass Switch box is located on the wall adjacent to the safety system rack.

The Bypass Box front door is equipped with a lockable handle. It uses the same key that is used for the PHENIX Safety System Bypass Box. During normal operation the box will be locked by the Watch Shift. They remain in possession of the key as is the case for PHENIX Safety System Bypass Box.

Fire Alarm Zone 11

RPC Safety Channel 1

The RPC Tent contains nine (9) photo-electric smoke detectors mounted on its ceiling. Their type, location, and spacing were approved by the BNL Fire Protection Engineer. The detectors are wired as a single zone and connected into the AGS building fire alarm panel zone 11. The fire panel's output relay contact for that zone connects to RPC Safety Channel input 1.

Flammable Gas Detector

RPC Safety Channel 2

A flammable gas monitor controller is matched with catalytic bead type sensors to make up the RPC Facility flammable gas detection system. The sensors will respond to isobutane which is part of the three gas mixture for the RPC chambers. The controller is a SmartMax II manufactured by Control Instruments Corporation. It is capable of reading up to four externally mounted sensors.

Only two sensors will be used. One sensor will be inside the tent, located on the Cosmic Ray Test Stand a few inches above floor level. The other sensor is outside the tent, located near the Gas mixing rack along the shield block wall.

Gas Monitor Set Points:

The Gas Controller alarm outputs will be set to respond at the following values. They are: LOW LEVEL ALARM = 5% full scale. HIGH LEVEL ALARM = 15% full scale. The controller also has a malfunction alarm output.

The low level and malfunction outputs are connected into the phone dialer alarm unit. The high level output triggers the Safety System channel 2.

The SmartMax System is the same type as used in the PHENIX Safety System to monitor the Gas Mixing House. It requires periodic re-calibration using a reference test gas.

SF6 Gas Monitor
RPC Safety Channel 3

The RPC Facility is provided with a SenTech SF6-MCD Sulfurhexafluoride monitor. The unit samples ambient air and measures the amount of halogen based gas in the air sample. The monitor has eight sample ports with one reference air (fresh air inlet) port and one exhaust port. A small diaphragm pump pulls sample air into the ports (one at a time), through a filter, into an infrared sensor, and out the exhaust port. Plastic tubing (¼ inch dia.) extends from the monitor ports to the various sensing areas located inside & outside the RPC tent.

Sensitivity to Refrigerants: The system is sensitive in varying amounts to many ozone depleting substances, including some of the halogen-based refrigerants, those containing molecules of fluorine, chlorine, or both. The sensor in the SF6-MCD has been selected to respond primarily to sulfurhexafluoride.

Factory Calibration: The monitor is calibrated at the factory prior to shipment. The system maintains accuracy through automatic re-zeroing. Periodically, the system switches to the fresh air inlet, and reestablishes a reference signal to which

it compares sample air. This process eliminates the potential variations caused by changes that develop in electronics as components age. If a change in infrared energy or detection of the infrared energy develops, that change will be first measured in the reference signal, then also in the sample. The PPM level is based on the ratio of the sample to the reference. This ratio eliminates the effect of any variations, and eliminates the need to periodically calibrate the monitor.

The low level and malfunction outputs are connected into the phone dialer alarm inputs .
The high level output triggers the Safety System channel 3.

Emergency-Stop "Crash" Push buttons

RPC Safety Channel 4

There are three crash push button stations. Two stations are located inside the tent and one is at the RPC Safety System Rack. Each push button will trip safety channel 4 and initiate electric power shutdown and closure of the gas valves. The buttons will lock in the (down) 'pushed" position and require a person to manually twist them in order to reset them (spring return to up) to normal.

Rack Automatic Phone Dialer

The RPC Safety System rack is connected to the BNL phone system via an analog line. The line terminates into an Omega "OMA-GUARD IT" phone dialer and a locally connected touchtone phone (mounted inside the rack) is used to load message recordings into it. These messages are activated by the safety system logic and sent to pre-programmed cell/home/pagers/BNL telephone numbers.

OMA-GUARD-IT Unit:
The Guard-it alarm auto dialer has a four input channel capability. Using a programming phone at the front panel, the user may pre-record voice messages up to 12 seconds in length for each channel. Eight phone numbers can be called. After receiving the alarm message, a person can acknowledge the alarm by pressing the "9" key on the phone. Acknowledgement will stop the dialer from calling the next phone number on the list. The auto dialer can also be remotely called and it will

answer. A system expert can then acknowledge alarms or check the health status of the unit.

It is intended that the only group authorized to acknowledge the phone alarms is the same group responsible for alarm response. Alarm response requires person(s) to report at the RPC Facility to assess the conditions and call for the assistance of system experts, if necessary.

Rack Uninterruptible Power Supply

The rack contains an APC 3KW UPS system capable of powering the rack and peripheral instruments in the event that normal AGS building 912 power is lost. The estimated "ride through" time is expected to be well over one hour. This will increase the reliability and availability of the safety system. Power (120 volt AC) for the Safety System control circuit's 24 volt DC power supply is delivered by the UPS. Therefore, following a long outage, the UPS batteries will expire, control power will be lost, all trip channel relays will drop out and the main contactor will drop out (tent power goes off & gas valves close). Also, the phone dialer will lose its capability to make outgoing alarm message calls.

The UPS does not deliver any 120 volt power to equipment inside the tent. However, UPS 24 volt (low current) control power will exist on the crash button circuit following a safety trip. Also, the flammable gas monitor's sensor power remains ON.

Procedure

2.0   Prerequisites

2.1   Calibrate/configure the flammable gas monitor to detect levels of Isobutane. Perform calibration in accordance with the SmartMax II instruction manual #H7SMX081 Rev. B, pages 13,14 and 15. Configure the low alarm set point to 5% LFL and the high alarm trip set point to 15% LFL.

2.2   The Sulfurhexafluoride (SF6) gas monitor is factory calibrated. Configure the alarm set points as follows: Low alarm = 50 ppm, main alarm = 100 ppm, high alarm = 150 ppm.

2.3   The BNL Fire/Rescue Group shall test the RPC facility fire alarm zone 11 smoke sensors for proper operation. Obtain documentation verifying that a zone 11 alarm will sound the bldg. 911 evacuation bells/strobes, trip the RPC Safety System fire alarm channel and report the zone trip in the BNL Fire Alarm Control Panel (FACP). Attach the document to this test procedure.

3.0   Local Trip and Alarm Channel Tests

Note: The following steps for each trip test section described below should be performed in order. The tests will be conducted using the local instrumentation installed in the vicinity of the RPC Tent facility. The indicators and controls are located inside/outside the tent. Panel mounted devices are contained on the RPC Safety System Rack (RPC-SS-R) and the Gas Mixing Panel (GMP) (located in the corridor outside the tent).

3.1   Fire Alarm zone 11 trip test

3.1.1 Trip Fire Alarm Zone 11 and verify the following conditions exist on the RPC-SS-R:
3.1.1.1   The fire alarm trip indicator light is flashing.
3.1.1.2   The master trip signal indicator light is on.
3.1.1.3   The alarm sounder is reporting.
3.1.1.4   The Main Power Contactor "ON" light is "off" and the contactor "OFF" light is "on".
3.1.1.5   The alarm sounder stops reporting after pressing the "alarm silence" button.

3.1.2 Verify the following conditions exist on the GMP.
3.1.2.1   The fault light is on.
3.1.2.2   All three solenoid operated gas valves (isobutane, SF6, Freon) are de-energized – closed.

Electrical power and gas flow to the RPC tent facility is now OFF.

3.1.3 Reset the fire alarm zone 11 trip. Verify the following conditions exist on the RPC-SS-R:

    3.1.3.1   The fire alarm trip indicator light turns off after pushing its reset button.

    3.1.3.2   The master trip signal indicator light turns off after pushing its reset button.

    3.1.3.3   The Main Contactor energizes after turning its switch to the ON position. The contactor "ON" light is "on" and the contactor "OFF" light is "off".

3.1.4 Reset the fault light on the GMP and verify the following conditions:

    3.1.4.1   The fault light turns off.

    3.1.4.2   All three solenoid operated gas valves are energized – open after pressing the 'power to valves" switch ON.

Electrical power and gas flow to the RPC tent facility is now restored ON.

3.2   <u>Flammable Gas trip test</u>

3.2.1 Trip the isobutane gas channel via admitting a flammable gas sample to each gas sensor and verify the following conditions exist:

    3.2.1.1   The isobutane alarm trip indicator light is flashing on the RPC-SS-R.

    3.2.1.2   The master trip signal indicator light is "on" on the RPC-SS-R.

    3.2.1.3   The alarm sounder is reporting on the RPC-SS-R.

    3.2.1.4   The **Yellow** alarm strobes/horns inside the tent and outside the tent are reporting.

    3.2.1.5   The Main Power Contactor "ON" light is "off" and the contactor "OFF" light is "on" on the RPC-SS-R.

3.2.1.6 The alarm sounder on the RPC-SS-R and the **yellow** strobes/horns stop reporting after pressing the "alarm silence" button.

3.2.2 Verify the following conditions exist on the GMP.
   3.2.2.1 Electrical power to the panel (via the power outlet box) is OFF.
   3.2.2.2 All three solenoid operated gas valves (isobutane, SF6, Freon) are de-energized – closed.

Electrical power and gas flow to the RPC tent facility is now OFF.

3.2.3 Reset the isobutane gas channel trip. Verify the following conditions exist on the RPC-SS-R:
   3.2.3.1 The isobutane gas channel trip indicator light turns off after pushing its reset button.
   3.2.3.2 The master trip signal indicator light turns off after pushing its reset button.
   3.2.3.3 The Main Contactor energizes after turning its switch to the ON position. The contactor "ON" light is on and the contactor "OFF" light is off.

3.2.4 Reset the fault light on the GMP and verify the following conditions:
   3.2.4.1 The fault light turns off.
   3.2.4.2 All three solenoid operated gas valves are energized – open after pressing the 'power to valves" switch ON.
   3.2.4.3 Electrical power (120VAC is now restored to the outlet box.

Electrical power and gas flow to the RPC tent facility is now restored ON.

3.3 SF6 Gas trip test

3.3.1 Trip the SF6 gas channel via admitting a R134A Freon or SF6 gas sample to each of the eight gas sensor ports and verify the following conditions exist:

    3.3.1.1 The SF6 gas high level trip indicator light is flashing on the RPC-SS-R.

    3.3.1.2 The alarm sounder is reporting on the RPC-SS-R.

    3.3.1.3 The **Blue** alarm strobes/horns inside the tent and outside the tent are reporting.

    3.3.1.4 The alarm sounder on the RPC-SS-R and the **Blue** strobes/horns stop reporting after pressing the "alarm silence" button.

3.3.2 Verify the following conditions exist on GMP.

    3.3.2.1 The fault light is ON.

    3.3.2.2 All three solenoid operated gas valves (isobutane, SF6, Freon) are de-energized – closed.

Electrical power remains ON and gas flow to the RPC tent facility is now OFF.

3.3.3 Reset the SF6 high level gas channel trip. Verify the following conditions exist on the RPC-SS-R:

    3.3.3.1 The isobutane gas high level gas channel trip indicator light turns off after pushing its reset button.

3.3.4 Reset the fault light on the GMP and verify the following conditions:

    3.3.4.1 The fault light turns off.

    3.3.4.2 All three solenoid operated gas valves are energized – open after pressing the 'power to valves" switch ON.

Gas flow to the RPC tent facility is now restored ON.

3.4 Emergency Stop (crash) push button trip test

3.4.1 Push each of the three crash buttons, one at a time, (two inside the tent and one on the RPC-SS-R) and verify the following conditions exist on the RPC-SS-R:

3.4.1.1 The E-stop trip indicator light is flashing.

3.4.1.2 The trip signal indicator light is on.

3.4.1.3 The alarm sounder is reporting.

3.4.1.4 The Main Power Contactor "ON" light is "off" and the contactor "OFF" light is "on".

3.4.1.5 The alarm sounder stops reporting after pressing the "alarm silence" button.

3.4.2 Verify the following conditions exist on the GMP.

3.4.2.1 The fault light is on.

3.4.2.2 All three solenoid operated gas valves (isobutane, SF6, Freon) are de-energized – closed.

Electrical power and gas flow to the RPC tent facility is now OFF.

3.4.3 Reset the crash button trip. Verify the following conditions exist on the RPC-SS-R:

3.4.3.1 The crash button trip indicator light turns off immediately when the crash buttons are reset.

3.4.3.2 The trip signal indicator light turns off after pushing its reset button.

3.4.3.3 The Main Contactor energizes after turning its switch to the ON position. The contactor "ON" light is "on" and the contactor "OFF" light is "off".

3.4.4 Reset the fault light on the GMP and verify the following conditions:

3.4.4.1 The fault light turns off.

3.4.4.2 All three solenoid operated gas valves are energized – open after pressing the 'power to valves" switch ON.

Electrical power and gas flow to the RPC tent facility is now restored ON.

3.5   Bypass Switch Tests

Note: The bypass switches are contained in the wall mounted enclosure, adjacent to the RPC-SS-R.

    3.5.1 Fire alarm Bypass switch.
        3.5.1.1   Place the Fire Alarm bypass switch to the "bypass" position.
        3.5.1.2   Trip fire alarm zone 11 input and verify that the channel does not trip.
        3.5.1.3   Return the switch to normal.

    3.5.2 Flammable Gas alarm bypass switch.
        3.5.2.1   Place the flammable gas alarm bypass switch to the bypass position.
        2.5.2.2   Trip the flammable gas channel input and verify the channel does not trip.
        2.5.2.3   Return the switch to normal.

    3.5.3 SF6 alarm Bypass switch.
        3.5.3.1   Place the SF6 bypass switch to the "bypass" position.
        3.5.3.2   Trip the SF6 channel input and verify that the channel does not trip.
        3.5.3.3   Return the switch to normal.

    3.5.4 Gas valves trip Bypass switch.
        3.5.4.1   Place the gas valves trip bypass switch to the "bypass" position.

3.5.4.2 Trip the crash button channel and verify that the fault light (on the gas mixing panel) does not turn on. The gas valves remain open.

3.5.4.3 Return the switch to normal.

3.5.5 Main contactor Bypass switch.

3.5.5.1 Place the main contactor bypass switch to the "bypass" position.

3.5.5.2 Trip the crash button channel and verify that the main contactor does not trip off.

3.5.5.3 Return the switch to normal.

3.5.6 Phone dialer Bypass switch.

3.5.6.1 Place the phone dialer bypass switch to the "bypass" position.

3.5.6.2 Trip the flammable gas channel and verify that Phone dialer alarm input 1 is disabled (the input 1 red light does not turn on).

3.5.6.3 Return the switch to normal.

4.0 Remote alarms channel tests

Note: The RPC Safety System will send alarms to remote locations via the use of an automatic electronic phone dialer unit contained in the RPC-SS-R. The unit is connected to the BNL phone system through a dedicated analog phone line. It is capable of placing alarm notification telephone calls to personnel, delivering specific pre-recorded messages. The dialer has a four channel input capacity. The alarm receptor phone number for each channel is

programmed into the dialer's memory. It will make the calls when the gas monitors' low or high set points are exceeded or if the gas monitors are malfunctioning. If the phone alarm is not answered or acknowledged by a person at the receptor phone, then, the dialer will continue to make alarm calls (indefinitely) to other phone numbers on the dialer's list, until it is acknowledged. For the purposes of this test, only one phone number was programmed into each of the dialer's four input channel's memory. If more than one alarm channel is tripped at the same time, then the dialer sends multiple alarm messages in a single phone call.

The Blue Sheet Test signature/verification card may indicate that the alarms are received at specific phones (CAS Watch Station, Main Control Room, PHENIX Control Room, etc.).

4.1   Phone dialer input channel 1 – **Flammable Gas High Level Detected**.

      4.1.1 Trip the Isobutane gas channel via admitting a flammable gas sample to any of the two gas sensors. Verify the following conditions:

            4.1.1.1   The channel 1 red LED on the dialer is blinking.

            4.1.1.2   The receptor phone receives a telephone call stating that high level flammable gas has been detected at the RPC Facility.

      4.1.2 After receiving the call, acknowledge the alarm by pressing the "9" key on the phone. Further alarm calls will be suspended by the dialer. Verify the following:

            4.1.2.1   The channel 1 red LED on the dialer is solid.

            4.1.2.2   After acknowledging and clearing the alarm at the RPC-SS-R, the channel 1 LED resets and returns to green.

4.2   Phone dialer input channel 2 – **SF6 Gas High Level Detected**.

      4.2.1 Trip the SF6 gas channel via admitting a gas sample to any of the eight gas sensor ports. Verify the following conditions:

4.2.1.1   The channel 2 red LED on the dialer is blinking.

4.2.1.2   The receptor phone receives a telephone call stating that high level SF6 gas has been detected at the RPC Facility.

4.2.2 After receiving the call, acknowledge the alarm by pressing the "9" key on the receptor phone. Further alarm calls will be suspended by the dialer. Verify the following:

4.2.2.1   The channel 2 red LED on the dialer is solid.

After acknowledging and clearing the alarm at the RPC-SS-R, the channel 2 LED resets and returns to green.

4.3   Phone dialer input channel 3 – **<u>Flammable gas low level or SF6 gas low level detected</u>**.

4.3.1 Trip the flammable gas low level alarm via admitting a flammable gas sample to any of the two gas sensors. Verify the following conditions:

The channel 3 red LED on the dialer is blinking.

4.3.2 The receptor phone receives a telephone alarm message stating that <u>low level flammable or SF6</u> gas has been detected at the RPC Facility.

4.3.3 After receiving the call, acknowledge the alarm by pressing the "9" key on the receptor phone. Further alarm calls will be suspended by the dialer. Verify the following:

4.3.3.1   The channel 3 red LED on the dialer is solid.

After acknowledging and clearing the alarm at the RPC-SS-R, the channel 3 LED resets and returns to green.

4.3.4 Trip the SF6 gas channel low level alarm via admitting a gas sample to any of the eight gas sensor ports. Verify the following conditions:

    4.3.4.1 The channel 3 red LED on the dialer is blinking.

    4.3.4.2 The receptor phone receives a telephone alarm message stating that low <u>level flammable or SF6</u> gas has been detected at the RPC Facility.

4.3.5 After receiving the call, acknowledge the alarm by pressing the "9" key on the receptor phone. Further alarm calls will be suspended by the dialer. Verify the following:

    4.3.5.1 The channel 3 red LED on the dialer is solid.

    After acknowledging and clearing the alarm at the RPC-SS-R, the channel 3 LED resets and returns to green.

4.4 Phone dialer input channel 4 – **<u>Flammable gas monitor malfunction or SF6 monitor malfunction</u>**.

4.4.1 Trip the flammable gas monitor malfunction alarm. Verify the following conditions:

    4.4.1.1 The channel 4 red LED on the dialer is blinking.

    4.4.1.2 The receptor phone receives a telephone alarm message stating that the <u>flammable gas or SF6</u> monitor at the RPC Facility is malfunctioning.

4.4.2 After receiving the call, acknowledge the alarm by pressing the "9" key on the receptor phone. Further alarm calls will be suspended by the dialer. Verify the following:

    4.4.2.1 The channel 4 red LED on the dialer is solid.

After acknowledging and clearing the alarm at the RPC-SS-R, the channel 4 LED resets and returns to green.

4.4.3 Trip the SF6 gas monitor malfunction alarm. Verify the following conditions:
    4.4.3.1   The channel 4 red LED on the dialer is blinking.
    4.4.3.2   The receptor phone receives a telephone alarm message stating that the <u>flammable gas or SF6</u> monitor is malfunctioning at the RPC Facility.

4.4.4 After receiving the call, acknowledge the alarm by pressing the "9" key on the receptor phone. Further alarm calls will be suspended by the dialer. Verify the following:
    4.4.4.1   The channel 4 red LED on the dialer is solid.
After acknowledging and clearing the alarm at the RPC-SS-R, the channel 4 LED resets and returns to green.

This completes the RPC Safety System Blue Sheet Certification Test

<u>**NOTES:**</u>

APPENDICES:

The following Documents are appended to this document:

1) PHENIX RPC BLUE SHEET MAINTENANCE AND SAFETY CHECKOFF LIST FOR APPARATUS EMPLOYING HAZARDOUS GAS (2 sheets)

2) RPC Facility Alarm Response Instructions

3) CAS Watch Alarm Response

4) RPC Factory Alarm signs

PHENIX RPC BLUE SHEET
MAINTENANCE AND SAFETY CHECK-OFF LIST FOR
APPARATUS EMPLOYING HAZARDOUS GAS
Proc. No. PP-2.5.5.6-10 Sheet 1 of 2

HAZARDOUS GAS TYPE: _____   LOCATION/COLUMN: _____

EXPERIMENTER: _____   NUMBER: _____   LIAISON: _____

<u>**PART-A**</u>

MAINTENANCE CONDITIONS TO BE SATISFIED PRIOR TO OPERATION
COMPLETE CHECKED ITEMS

	Note	Items	Date	By
Fire Detection & Protection Operational	1			
Fire Extinguishers (2 Minimum)	2			
Phenix RPC Tent gas detection system operational	3			
Gas mixing system operational	4			
Portable gas detection at CAS	5			
Warning signs (flammable gas)	6			
Ground fault system operational	7			
Emergency lighting operational	8			
UPS operational	9			
Emergency systems off (Crash systems) operational	10			
Exit paths cleared	11			
Safety review	12			
All extraneous material removed	13			
All action sheets posted	14			
Set all bypass settings to normal status	15			

ABOVE ITEMS COMPLETED: DATE: _____ TIME: _____BY: _____
                                                                           CAD Liaison Engineer

SPECIAL INSTRUCTIONS / COMMENTS

PHENIX RPC BLUE SHEET
MAINTENANCE AND SAFETY CHECK-OFF LIST FOR
APPARATUS EMPLOYING HAZARDOUS GAS
Proc. No. PP-2.5.5.6-10 Sheet 2 of 2

PART-B
OPERATIONAL CHECK-OFF FOR FILLING A HAZARDOUS GAS SYSTEM

HAZARDOUS GAS TYPE: _____ LOCATION/COLUMN: _____

EXPERIMENTER: _____ NUMBER: _____ LIAISON: _____

APPROVAL TO FILL DEVICE DATE: _____ TIME: _____ BY: _____

DEVICE PURGED BEDORE FILL: DATE: _____ TIME: _____ BY: _____
HAZARDOUS GAS OPERATOR

PERMISSION TO FILL DATE: _____ TIME: _____ BY: _____
CAD LIAISON ENGINEER

PART-C
OPERATIONAL CHECK-OFF FOR DUMPING A HAZARDOUS GAS SYSTEM

DUMP STARTED: DATE: _____ TIME: _____ BY: _____
CAD LIAISON ENGINEER

REASON:_____

CONDITIONS TO BE SATISFIED BEFORE DUMP IS COMPLETED COMPLETE CHECKED ITEMS	Note	Items	Date	By
Device Purged and Cleared of Hazardous Gas	1			
Vent System Purged and Cleared of Hazardous Gas	2			
Bleed Off Any Pressure Lines	3			
Hazardous Gas or Liquid Removed	4			
Coordinator Notified (Area Cleared of Gas)	5			

DUMP COMPLETED DATE: _____ TIME: _____ BY: _____
CAD LIAISON ENGINEER

PART-D
OPERATIONAL CHECK-OFF FOR DUMPING A HAZARDOUS GAS SYSTEM
COMPLETE CHECKED ITEMS

	Note	Items	Date	By
Warning/Flammable Gas Signs Turned Off or Removed	1			
All Monitoring Equipment is Locked Out	2			

ABOVE ITEMS COMPLETED: DATE: _____ TIME: _____ BY: _____
CAD LIAISON ENGINEER

RPC Facility Alarm Response Instructions

1. Safety System Alarm Channel 1 – FIRE ALARM

1.1   Reason for alarm:

1.1.1   Smoke has been detected by any of the nine (9) ceiling mounted photoelectric smoke sensors inside the RPC Tent.

1.2   Local and remote alarm indications/automatic safety actions:

1.2.1   BNL Fire alarm evacuation bells and strobes reporting in the building 912 high bay general area.
1.2.2   BNL Fire Alarm Panel #157 indicates a Zone 11 trip.
1.2.3   BNL Firehouse alarm activates for building 912 zone 11.
1.2.4   The RPC Safety System Rack audible & visual indicators report a Zone 11 Fire Alarm trip.
1.2.5   RPC electrical power trips off and gas valves close.

1.3   RPC personnel response:

1.3.1   Evacuate the tent and high bay area to locations outside the building.

1.4   Emergency personnel response:

1.4.1   The BNL Fire/Rescue Group will respond with fire trucks/emergency gear.

1.5   System Expert Response:

1.5.1   Following the instructions by emergency personnel for safe re-entry into the area, further evaluate cause of trip. Reset local alarm indicators and restore the RPC equipment to normal.

2. **Safety System Alarm Channel 2 – HIGH LEVEL FLAMMABLE GAS (Isobutane) detected**.

2.1   Reason for alarm:

2.1.1 Flammable gas has been detected (above 15% LFL) inside the tent near the Cosmic ray test stand and/or outside the tent near the Gas Mixing Panel.

2.2   Local and remote alarm indications/automatic safety actions:

2.2.1 Evacuation alarm horns/strobes (YELLOW) report inside and outside the tent.
2.2.2 The RPC Safety System Rack audible & visual indicators report a high level flammable gas trip.
2.2.3 RPC electrical power trips off and gas valves close.
2.2.4 The Safety System Phone dialer calls the CAS Watch station (dialer alarm #1) telephone and delivers the alarm condition message.

2.3   RPC personnel response:

2.3.1 Evacuate the tent and high bay area to locations outside the building.

2.4   Emergency personnel response:

2.4.1 CAS Watch personnel report to the RPC Facility, assess conditions, notify BNL Fire dept. if necessary, and notify system experts.

2.5   System Expert Response:

2.5.1 Following the instructions by emergency personnel for safe re-entry into the area, further evaluate cause of trip. Reset local alarm indicators and restore the RPC equipment to normal.

3. Safety System Alarm Channel 3 – HIGH LEVEL Sulfurhexafluoride (SF6) GAS detected.

3.1.<u>Reason for alarm:</u>

    3.1.1. SF6 gas has been detected (above 150 PPM) inside the tent near the Cosmic ray test stand and/or outside the tent near the Gas Mixing Panel.

    3.1.2. <u>Local and remote alarm indications/automatic safety actions:</u>

    3.1.3. Evacuation alarm horns/strobes (BLUE) report inside and outside the tent.

    3.1.4. The RPC Safety System Rack audible & visual indicators report a high level flammable gas trip.

    3.1.5. RPC electrical power remains ON and gas valves close.

    3.1.6. The Safety System Phone dialer calls the CAS Watch station (dialer alarm #2) telephone and delivers the alarm condition message.

3.2<u>RPC personnel response:</u>

      3.2.1 Evacuate the tent and high bay area to locations outside the building.

3.3<u>Emergency personnel response:</u>

      3.3.1 CAS Watch personnel report to the RPC Facility, assess conditions, notify BNL Fire dept. if necessary and notify system experts.

3.4<u>System Expert Response:</u>

      3.4.1 Following the instructions by emergency personnel for safe re-entry into the area, further evaluate cause of trip. Reset local alarm indicators and restore the RPC equipment to normal.

4. Safety System Alarm Channel 4 – Emergency Stop "CRASH" Push buttons pressed.

4.1. Reason for alarm:

    4.1.1. Any of the three crash push buttons have been pressed. Two are located inside the tent. The third is on the RPC Safety System Rack.

4.2. Local and remote alarm indications/automatic safety actions:

    4.2.1. The RPC Safety System Rack audible & visual indicators report an emergency stop trip.

    4.2.2. RPC electrical power trips off and gas valves close.

4.3. RPC personnel response:

    4.3.1   Make determination if the emergency action requires further assistance by BNL Fire/rescue. If so, pull the local fire alarm pull station and call 2222.

4.4. Emergency personnel response:

    4.4.1. CAS Watch personnel report to the RPC Facility, assess conditions, notify BNL Fire dept. if necessary and notify system experts.

4.5. System Expert Response:

Following the instructions by emergency personnel for safe re-entry into the area, (if they are present) further evaluate conditions. Reset local alarm indicators and restore the RPC equipment to normal.

5. Safety System Alarm (alarm only – no trip action) – Low Level Flammable Gas detected.

5.1.Reason for alarm:

5.1.1   Flammable gas has been detected (above 5% LFL) inside the tent near the Cosmic ray test stand and/or outside the tent near the Gas Mixing Panel.

5.2.Local and remote alarm indications/automatic safety actions:

5.2.1. There are no automatic trip actions taken. The Safety System Rack phone dialer places an alarm message (dialer alarm #3) call.

5.3.RPC personnel response:

5.3.1   There are no audible warnings to the RPC personnel for low level flammable gas detection.

5.4.Emergency personnel response:
5.4.1. CAS Watch personnel report to the RPC Facility, assess conditions, and notify system experts.

5.5.System Expert Response:

Following the instructions by emergency personnel for safe re-entry into the area, further evaluate cause of alarm. Reset local alarm indicators and restore the RPC equipment to normal.

6.   Safety System Alarm (alarm only – no trip action) – Low Level SF6 Gas detected.

6.1Reason for alarm:

6.1.1   SF6 gas has been detected (above 50 PPM) inside the tent at various

areas and/or outside the tent near the Gas Mixing Panel.

6.2 Local and remote alarm indications/automatic safety actions:

6.2.1 There are no automatic trip actions taken. The Safety System Rack phone dialer places an alarm message (alarm #3) call.

6.3 RPC personnel response:

There are no audible warnings to the RPC personnel for low level SF6 gas detection.

6.4 Emergency personnel response:

6.4.1 CAS Watch personnel report to the RPC Facility, assess conditions, and notify system experts.

6.5 System Expert Response:

Following the instructions by emergency personnel for safe re-entry into the area, further evaluate cause of alarm. Reset local alarm indicators and restore the RPC equipment to normal.

7. **Safety System Alarm (alarm only – no trip action) – Flammable Gas Monitor Malfunction.**

7.1 Reason for alarm:

7.1.1 The Flammable Gas Monitor is signaling a malfunction.

7.2 Local and remote alarm indications/automatic safety actions:

7.2.1 There are no automatic trip actions taken. The Safety System Rack phone dialer places an alarm message (dialer alarm #4) call.

7.3 RPC personnel response:

There are no audible warnings to the RPC personnel for gas monitor malfunction.

7.4 <u>Emergency personnel response:</u>
    7.4.1 CAS Watch personnel report to the RPC Facility, assess conditions, and notify system experts.

7.5 <u>System Expert Response:</u>

Following the instructions by emergency personnel for safe re-entry into the area, further evaluate cause of alarm. Reset local alarm indicators and restore the RPC equipment to normal.

8. **Safety System Alarm (alarm only – no trip action) – SF6 Gas Monitor Malfunction.**

8.1 <u>Reason for alarm:</u>

8.1.1   The SF6 Gas Monitor is signaling a malfunction.

8.2 <u>Local and remote alarm indications/automatic safety actions:</u>

    8.2.1 There are no automatic trip actions taken. The Safety System Rack phone dialer places an alarm message (dialer alarm #4) call.

8.3 <u>RPC personnel response:</u>

There are no audible warnings to the RPC personnel for gas monitor malfunction.

8.4 <u>Emergency personnel response:</u>
    8.4.1 CAS Watch personnel report to the RPC Facility, assess conditions, and notify system experts.

8.5 <u>System Expert Response:</u>

Following the instructions by emergency personnel for safe re-entry into the area, further evaluate cause of alarm. Reset local alarm indicators and restore the RPC equipment to normal.

<u>NOTES:</u>

CAS Watch Response to PHENIX RPC Factory Alarms:

1. Fire Alarm (Alarm Channel 1)

- BNL Fire/Rescue Group will respond.
- CAS is notified via its Fire Alarm Panel and/or radio call from Fire Dept.
- Report to the RPC facility. Notify RPC system experts using info on posted call out sheet.

2. High Level Flammable Gas Detected (Alarm Channel 2, dialer alarm #1)

- Report to the RPC Facility, monitor for Isobutane gas (heavier than air) with handheld instrument. Notify BNL Fire Dept. if necessary.
- Silence the alarm horns via pressing the "alarm silence" push button on the RPC Safety System Rack. Verify tent power OFF and solenoid gas valves CLOSED (white lights are out on the gas mixing panel and red fault light is on).
- CLOSE the manual valves on the gas bottles.
- If tent power is ON or the solenoid gas valves are OPEN, then press the emergency off "Crash" push button on the RPC Safety System Rack.
- Notify RPC system experts using info on posted call out sheet.

3. High Level (SF$_6$) Gas Detected (Alarm Channel 3, dialer alarm #2)

- Report to the RPC Facility, monitor for SF6 gas (heavier than air) with handheld instrument. Notify BNL Fire Dept. if necessary.
- Silence the alarm horns via pressing the "alarm silence" push button on the RPC Safety System Rack. Tent power remains ON. Verify solenoid gas valves CLOSED (white lights are out on the gas mixing panel and red fault light is on).
- Close the manual valves on the gas bottles.
- If the solenoid gas valves are OPEN, then press the emergency off "Crash" push button on the RPC Safety System Rack
- Notify RPC system experts using info on posted call out sheet.

4. Emergency Stop "CRASH" Push buttons pressed. (Alarm Channel 4)

- Report to the RPC Facility,
- Assess conditions and determine if personnel are injured, notify BNL Fire dept. if necessary.
- Notify RPC system experts using info on posted call out sheet.

5. Low Level Flammable Gas/SF$_6$ detected. (Automatic dialer alarm #3)

- Report to the RPC Facility, monitor for Isobutane gas or SF6 gas (heavier than air) with handheld instruments. Notify BNL Fire Dept. if necessary.
- There are no automatic shut down actions.
- Notify RPC system experts using info on posted call out sheet.

6. Flammable Gas/SF$_6$ Monitor Malfunction. (Automatic dialer alarm #4)

- Report to the RPC Facility.
- There are no automatic shut down actions.
- Notify RPC system experts using info on posted call out sheet.

PHENIX RPC Factory Warning Signs

The following signs are to be posted adjacent to their respective strobe light alarms:

1) Adjacent to blue/white strobe light for SF_6 alarm:

CAUTION: SF_6 ALARM

EVACUATE
WHEN FLASHING

2) Adjacent to yellow/white strobe light for flammable gas:

CAUTION: FLAMMABLE GAS ALARM

EVACUATE
WHEN FLASHING